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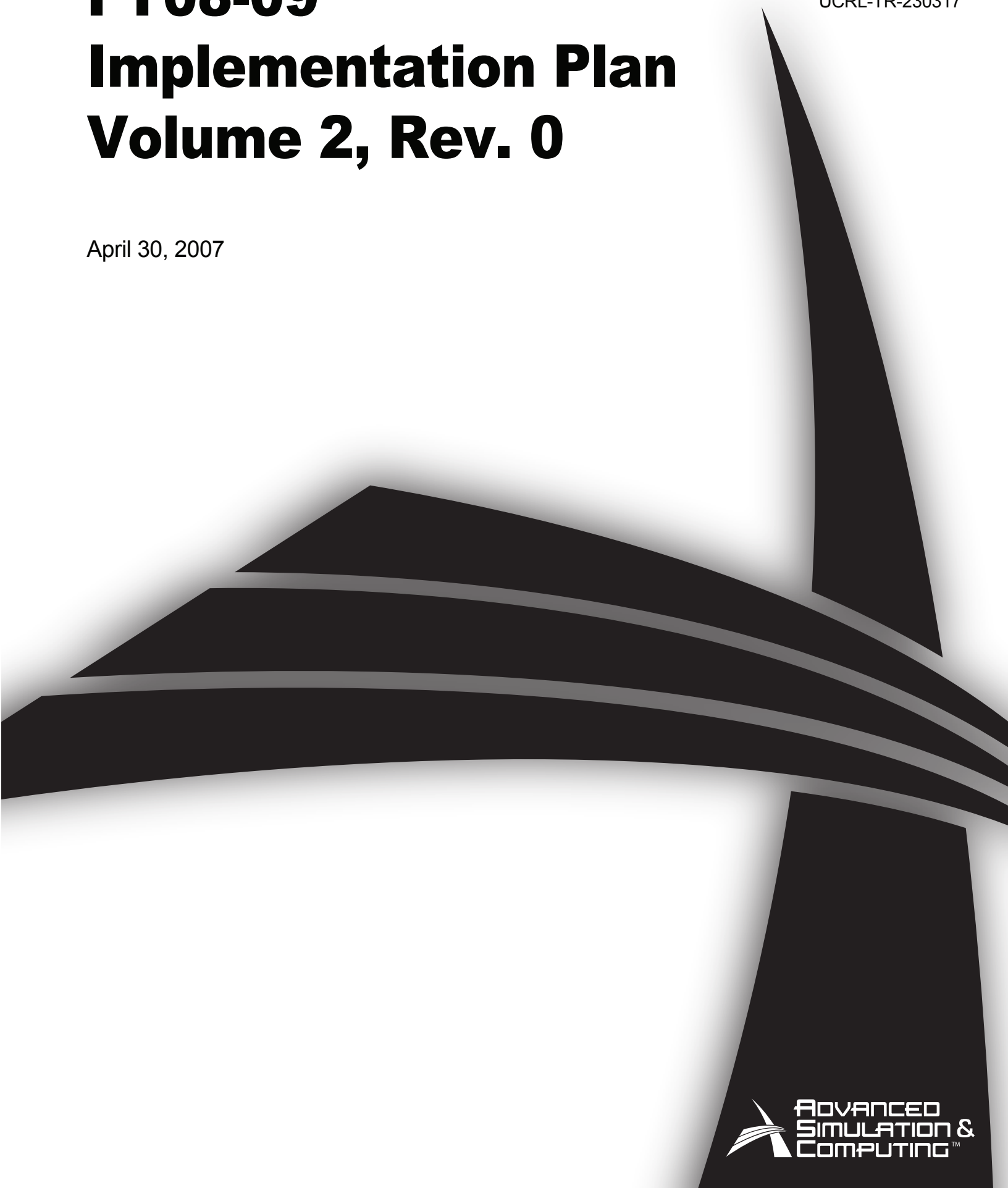
April 30, 2007



Advanced Simulation & Computing™

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Advanced Simulation and Computing

FY08–09 IMPLEMENTATION PLAN
Volume 2, Rev. 0

April 30, 2007

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I. Executive Summary

The Stockpile Stewardship Program (SSP) is a single, highly integrated technical program for maintaining the safety and reliability of the U.S. nuclear stockpile. The SSP uses past nuclear test data along with current and future nonnuclear test data, computational modeling and simulation, and experimental facilities to advance understanding of nuclear weapons. It includes stockpile surveillance, experimental research, development and engineering programs, and an appropriately scaled production capability to support stockpile requirements. This integrated national program requires the continued use of current facilities and programs along with new experimental facilities and computational enhancements to support these programs.

The Advanced Simulation and Computing Program (ASC)[1] is a cornerstone of the SSP, providing simulation capabilities and computational resources to support the annual stockpile assessment and certification, to study advanced nuclear-weapons design and manufacturing processes, to analyze accident scenarios and weapons aging, and to provide the tools to enable Stockpile Life Extension Programs (SLEPs) and the resolution of Significant Finding Investigations (SFIs). This requires a balanced resource, including technical staff, hardware, simulation software, and computer science solutions.

In its first decade, the ASC strategy focused on demonstrating simulation capabilities of unprecedented scale in three spatial dimensions. In its second decade, ASC is focused on increasing its predictive capabilities in a three-dimensional simulation environment while maintaining the support to the SSP. The program continues to improve its unique tools for solving progressively more difficult stockpile problems (focused on sufficient resolution, dimensionality and scientific details); to quantify critical margins and uncertainties (QMU); and to resolve increasingly difficult analyses needed for the SSP. Moreover, ASC has restructured its business model from one that was very successful in delivering an initial capability to one that is integrated and focused on requirements-driven products that address long-standing technical questions related to enhanced predictive capability in the simulation tools.

ASC must continue to meet three objectives:

- **Objective 1. Robust Tools.** Develop robust models, codes, and computational techniques to support stockpile needs such as refurbishments, SFIs, LEPs, annual assessments, and evolving future requirements.
- **Objective 2. Prediction through Simulation.** Deliver validated physics and engineering tools to enable simulations of nuclear-weapons performances in a variety of operational environments and physical regimes and to enable risk-informed decisions about the performance, safety, and reliability of the stockpile.
- **Objective 3. Balanced Operational Infrastructure.** Implement a balanced computing platform acquisition strategy and operational infrastructure to meet Directed Stockpile Work (DSW) and SSP needs for capacity and high-end simulation capabilities.

[1] In FY02 the Advanced Simulation and Computing (ASC) Program evolved from the Accelerated Strategic Computing Initiative (ASCI).

II. Introduction

The ASC Program supports the National Nuclear Security Administration's (NNSA's) long-term strategic goal of Nuclear Weapons Stewardship: *"ensure that our nuclear weapons continue to serve their essential deterrence role by maintaining and enhancing the safety, security, and reliability of the U.S. nuclear weapons stockpile."*[2]

In 1996, ASCI—the Accelerated Strategic Computing Initiative—was established as an essential element of the SSP to provide nuclear weapons simulation and modeling capabilities.

In 2000, the NNSA was established to carry out the national security responsibilities of the Department of Energy, including maintenance of a safe, secure, and reliable stockpile of nuclear weapons and associated materials capabilities and technologies.

Shortly thereafter, in 2002, ASCI matured from an initiative to a recognized program and was renamed the Advanced Simulation and Computing (ASC) Program.

Prior to the start of the nuclear testing moratorium in October 1992, the nuclear weapons stockpile was maintained through (1) underground nuclear testing and surveillance activities and (2) "modernization" (i.e., development of new weapons systems). A consequence of the nuclear test ban is that the safety, performance, and reliability of U.S. nuclear weapons must be ensured by other means for systems far beyond the lifetimes originally envisioned when the weapons were designed.

NNSA will carry out its responsibilities through the twenty-first century in accordance with the current Administration's vision and the Nuclear Posture Review (NPR) guidance. NNSA Administrator Ambassador Brooks summarized[3] the NNSA objectives for SSP as follows:

"We will continue to lead the way to a safer world through the deep reductions in nuclear forces codified by the Moscow Treaty, through Nunn-Lugar and other cooperative threat reduction efforts, and through other actions. At the same time, although conventional forces will assume a larger share of the deterrent role, we will maintain an effective, reliable, and capable—though smaller—nuclear force as a hedge against a future that is uncertain and in a world in which substantial nuclear arsenals remain. Our ongoing efforts to reduce the current stockpile to the minimum consistent with national security requirements, to address options for transformation of this smaller stockpile, and to create a responsive nuclear weapons infrastructure are key elements of the Administration's national security strategy…"

A truly responsive infrastructure will allow us to address and resolve any stockpile problems uncovered in our surveillance program; to adapt weapons (achieve a capability to modify or repackage existing warheads within 18 months of a decision to enter engineering development); to be able to design, develop, and initially produce a new warhead within three to four years of a decision to do so;[4] to restore production

[2] NNSA Strategic Plan, page 8.

[3] Speech presented to the Heritage Foundation Conference: *U.S. Strategic Command: Beyond the War on Terrorism*, May 12, 2004.

[4] While there are no plans to develop new weapons, gaining the capability is an important prerequisite to deep reductions in the nuclear stockpile.

capacity to produce new warheads in sufficient quantities to meet any defense needs that arise without disrupting ongoing refurbishments; to ensure that services such as warhead transportation, tritium support, and other ongoing support efforts are capable of being carried out on a time scale consistent with the Department of Defense's ability to deploy weapons; and to improve test readiness (an 18-month test readiness posture) in order to be able to diagnose a problem and design a test that could confirm the problem or certify the solution (without assuming any resumption of nuclear testing).

Additionally, the NPR guidance has directed that NNSA maintain a research and development and manufacturing base that ensures the long-term effectiveness of the nation's stockpile and begin a modest effort to examine concepts (for example, Advanced Concepts Initiatives, including the Robust Nuclear Earth Penetrator) that could be deployed to further enhance the deterrent capabilities of the stockpile in response to the national security challenges of the twenty-first century.

The ASC Program plays a vital role in the NNSA infrastructure and its ability to respond to the NPR guidance. The program focuses on development of modern simulation tools that can provide insights into stockpile problems, provide tools with which designers and analysts can certify nuclear weapons, and guide any necessary modifications in nuclear warheads and the underpinning manufacturing processes. Additionally, ASC is enhancing the predictive capability necessary to evaluate weapons effects, design experiments, and ensure test readiness.

ASC continues to improve its unique tools to solve progressively more difficult stockpile problems, with a focus on sufficient resolution, dimensionality, and scientific details, to quantify critical margins and uncertainties (QMU), to resolve the increasingly difficult analyses needed for stockpile stewardship. The DSW provides requirements for simulation, including planned SLEPs, stockpile support activities that may be ongoing or require short-term urgent response, and requirements for future capabilities to meet longer-term stockpile needs. Thus, ASC's advancing leading-edge technology in high-performance computing and predictive simulation meets these short- and long-term needs, including the annual assessments and certifications and SFIs. The following section lists past, present, and planned ASC contributions to meet these needs.

ASC Contributions to the Stockpile Stewardship Program

In FY96, ASCI Red was delivered. Red, the world's first teraflops supercomputer, was upgraded to more than 3 teraflops in FY99 and was retired from service in September 2005.

In FY98, ASCI Blue Pacific and ASCI Blue Mountain were delivered. These platforms were the first 3-teraops systems in the world and have both since been decommissioned.

In FY00, ASCI successfully demonstrated the first-ever three dimensional (3D) simulation of a nuclear weapon primary explosion and the visualization capability to analyze the results; ASCI successfully demonstrated the first-ever 3D hostile-environment simulation; and ASCI accepted delivery of ASCI White, a 12.3-teraops supercomputer, which has since been retired from service.

In FY01, ASCI successfully demonstrated simulation of a 3D nuclear weapon secondary explosion; ASCI delivered a fully functional Problem Solving Environment for ASCI White; ASCI demonstrated high-bandwidth distance computing between the three national laboratories; and ASCI demonstrated the initial validation methodology for early primary behavior. Lastly, ASCI completed the 3D analysis for a stockpile-to-target sequence (STS) for normal environments.

In FY02, ASCI demonstrated 3D system simulation of a full-system (primary and secondary) thermonuclear weapon explosion, and ASCI completed the 3D analysis for an STS abnormal-environment crash-and-burn accident involving a nuclear weapon.

In FY03, ASCI delivered a nuclear safety simulation of a complex, abnormal, explosive initiation scenario; ASCI demonstrated the capability of computing electrical responses of a weapons system in a hostile (nuclear) environment; and ASCI delivered an operational 20-teraops platform on the ASCI Q machine.

In FY04, ASC provided simulation codes with focused model validation to support the annual certification of the stockpile and to assess manufacturing options. ASC supported the life-extension refurbishments of the W76 and W80, in addition to the W88 pit certification. In addition, ASC provided the simulation capabilities to design various nonnuclear experiments and diagnostics.

In FY05, ASC identified and documented SSP requirements to move beyond a 100-teraops computing platform to a petaFLOPS-class system; ASC delivered a metallurgical structural model for aging to support pit-lifetime estimations, including spiked-plutonium alloy. In addition, ASC provided the necessary simulation codes to support test readiness as part of NNSA's national priorities.

In FY06, ASC delivered the capability to perform nuclear performance simulations and engineering simulations related to the W76/W80 LEPs to assess performance over relevant operational ranges, with assessments of uncertainty levels for selected sets of simulations. The deliverables of this milestone were demonstrated through 2D and 3D physics and engineering simulations. The engineering simulations analyzed system behavior in abnormal thermal environments and mechanical response of systems to hostile blasts. Additionally, confidence measures and methods for uncertainty quantification were developed to support weapons certification and QMU Level 1 milestones.

In FY07, ASC supported the completion of the W76-1 and W88 warhead certification, using quantified design margins and uncertainties; ASC also provided a robust 100-teraFLOPS-platform production environment supporting DSW and Campaign simulation requirements. This was augmented by the 360-teraFLOPS ASC BlueGene/L system, which provided additional capability for science campaigns.

By FY08, ASC will deliver the codes for experiment and diagnostic design to support the CD-4 approval on the National Ignition Facility (NIF). An advanced architecture platform capable of sustaining a 1-petaFLOPS benchmark will be sited at Los Alamos National Laboratory (LANL).

By FY09, a modern baseline of all enduring stockpile systems, using ASC codes, will be completed.

In FY10 and beyond, ASC will continue to deliver codes for experiment and diagnostic design to support the indirect-drive ignition experiments on the NIF and will continue to improve confidence and response time for predictive capabilities to answer questions of vital importance to the SSP.

Table II-1. Defense Program Campaigns

Campaign Number	Campaign Title
C1	Primary Assessment Technology and Test Readiness
C2	Dynamic Materials Properties
C3	Advanced Radiography
C4	Secondary Assessment Technology
C5	Enhanced Surety
C6	Weapon Systems Engineering Assessment Technology
C7	Nuclear Survivability
C8	Enhanced Surveillance
C9	Advanced Design & Production Technologies
C10	Inertial Confinement Fusion Ignition and High Yield Campaign
C11	Advanced Simulation and Computing
C12	Pit Manufacturing and Certification Campaign
C15	Nonnuclear Readiness
C16	Materials Readiness
C18	Engineering Campaigns Construction Activities
C19	Advanced Design & Production Technologies Readiness

The National Work Breakdown Structure

ASC's program structure is based on the new national work breakdown structure (nWBS), described in the ASC Business Model (NA-ASC-104R-05-Vol.1-Rev.5).

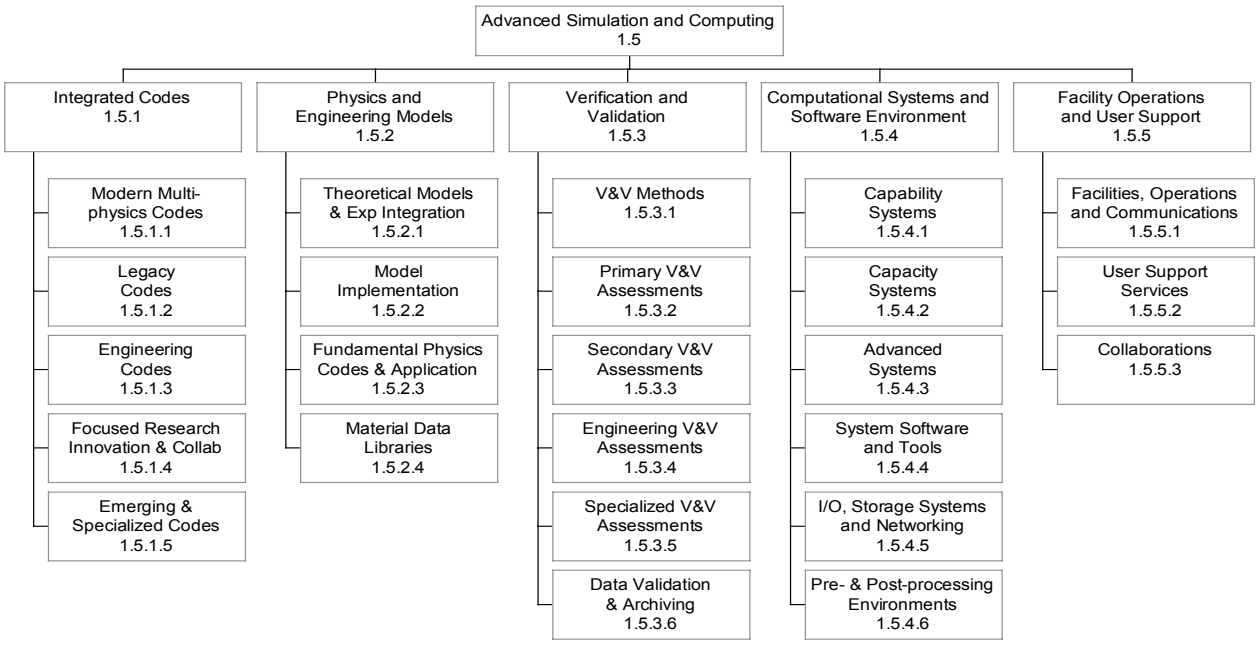


Figure II-1. The ASC program structure is based on the new national work breakdown structure.

Sub-Programs

As the chart visualizes, ASC is divided into five sub-programs:

- Integrated Codes
- Physics and Engineering Models
- Verification and Validation
- Computational Systems and Software Environment
- Facility Operations and User Support

The first three sub-programs focus on improved models in the modern codes, delivery of validated tools, and response to SSP issues (for example, SFIs, LEPs, annual assessments). Key drivers are to improve the confidence in prediction through simulations; to calculate, measure, and understand the uncertainty in the predictions; and to ensure rapid delivery of simulation capabilities to the SSP.

The fourth sub-program, Computational Systems and Software Environment, ensures the development and deployment of a computing environment needed for all ASC-deployed platforms: capability, capacity, and advanced systems.[5] Not only is this sub-

[5] The ASC Program is in transition for current platforms. Future platforms will follow the Capital Acquisition Management process identified in the NA-10 *Program Management Manual*.

program responsible for related research and technology development, but it is also responsible for planning, procurement, and quality control activities.

The fifth, and last, sub-program, Facility Operations and User Support, provides operational support for production computing and storage, user support services, and collaborative research opportunities with educational institutions, as well as programmatic support across the ASC program.

Product Deliverables

The Product deliverables are described at level 4 and span the full-scope of the program in the context of the nWBS. They describe what the Laboratories expect to provide to a given Product as a result of their activities.

Deliverables can, but do not necessarily, contribute to level 2 milestones chosen in a given fiscal year. Deliverables that do directly contribute to level 2 milestones for the fiscal year will be reviewed in the context of level 2 milestone reviews.

III. Accomplishments for FY06–FY07

ASC accomplishments from Quarter 4, fiscal year 2006, through quarter 3, fiscal year 2007, are reflected below for the Computational Systems and Software Environment (CSSE) and Facility Operations and User Support (FOUS) sub-programs.

HQ is pleased to highlight the outstanding achievements of the Defense Programs Contractors.

Computational Systems and Software Environment

LLNL Accomplishments for Computational Systems and Software Environment

Accomplishments will be added in Rev. 0.1 of this document.

LANL Accomplishments for Computational Systems and Software Environment

Accomplishments will be added in Rev. 0.1 of this document.

SNL Accomplishments for Computational Systems and Software Environment

Accomplishments will be added in Rev. 0.1 of this document.

Facility Operations and User Support

LLNL Accomplishments for Facility Operations and User Support

Accomplishments will be added in Rev. 0.1 of this document.

LANL Accomplishments for Facility Operations and User Support

Accomplishments will be added in Rev. 0.1 of this document.

SNL Accomplishments for Facility Operations and User Support

Accomplishments will be added in Rev. 0.1 of this document.

IV. Product Descriptions by the National Work Breakdown Structure

WBS 1.5.4: Computational Systems and Software Environment

The mission of this national sub-program is to build integrated, balanced, and scalable computational capabilities to meet the predictive simulation requirements of NNSA. It strives to provide users of ASC computing resources a stable and seamless computing environment for all ASC-deployed platforms, which include capability, capacity, and advanced systems. Along with these powerful systems that ASC will maintain and continue to field, the supporting software infrastructure that CSSE is responsible for deploying on these platforms includes many critical components, from system software and tools, to Input/Output (I/O), storage and networking, to pre- and post-processing visualization and data analysis tools. Achieving this deployment objective requires sustained investment in applied research and development activities to create technologies that address ASC's unique mission-driven need for scalability, parallelism, performance, and reliability.

WBS 1.5.4.1: Capability Systems

This level 4 product provides capability production platforms and integrated planning for the overall system architecture commensurate with projected user workloads. The scope of this product includes strategic planning, research, development, procurement, hardware maintenance, testing, integration and deployment, and quality and reliability activities, as well as industrial and academic collaborations. Projects and technologies include strategic planning, performance modeling, benchmarking, and procurement and integration coordination. This product also provides market research for future systems.

Capability Systems Deliverables for FY08

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

WBS 1.5.4.2: Capacity Systems

This level 4 product provides capacity production platforms commensurate with projected user workloads. The scope of this product includes planning, research, development, procurement, hardware maintenance, testing, integration and deployment, and quality and reliability activities, as well as industrial and academic collaborations. Projects and technologies include the procurement and installation of capacity platforms.

Capacity Systems Deliverables for FY08

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

WBS 1.5.4.3: Advanced Systems

This level 4 product provides advanced architectures in response to programmatic, computing needs. The scope of this product includes strategic planning, research, development, procurement, testing, integration and deployment, as well as industrial and academic collaborations. Projects and technologies include strategic planning, performance modeling, benchmarking, and procurement and integration coordination. This product also provides market research, and the investigation of advanced architectural concepts and hardware (including node interconnects and machine area networks) via prototype development, deployment and testbed activities. Also included in this product are cost-effective computers designed to achieve extreme speeds in addressing specific, stockpile-relevant issues through development of enhanced performance codes especially suited to run on the systems.

Advanced Systems Deliverables for FY08

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

WBS 1.5.4.4: System Software and Tools

This level 4 product provides the system software infrastructure, including the supporting operating system environments and the integrated tools to enable the development, optimization and efficient execution of application codes. The scope of this product includes planning, research, development, integration and initial deployment, continuing product support, and quality and reliability activities, as well as industrial and academic collaborations. Projects and technologies include system-level software addressing optimal delivery of system resources to end-users, such as schedulers, custom device drivers, resource allocation, optimized kernels, system management tools, compilers, debuggers, performance tuning tools, run-time libraries, math libraries, component frameworks, other emerging programming paradigms of importance to scientific code development and application performance analysis.

System Software and Tools Deliverables for FY08

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

WBS 1.5.4.5: Input/Output, Storage Systems, and Networking

This level 4 product provides I/O (input/output, or data transfer) storage infrastructure in balance with all platforms and consistent with integrated system architecture plans. The procurement of all supporting subsystems, and data transfer, storage systems and infrastructures occurs through this product. The scope of this product includes planning, research, development, procurement, hardware maintenance, integration and deployment, continuing product support, and quality and reliability activities, as well as industrial and academic collaborations. Projects and technologies include high-performance parallel file systems, hierarchical storage management systems, storage-

area-networks, network-attached storage (NAS), and HPSS or future hierarchical storage management system disks, tape, robotics, servers, and media. This product also includes relevant prototype deployment and testbed activities. Projects and technologies in the advanced networking and interconnect areas shall include networking and interconnect architectures, emerging networking hardware technologies and communication protocols, network performance/security monitoring/analysis tools, and high performance encryption and security technologies.

Input/Output, Storage Systems, and Networking Deliverables for FY08

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

WBS 1.5.4.6: Pre- and Post-Processing Environments

This level 4 product provides integrated environments to support end-user simulation set up, and post-processing visualization, data analysis and data management. The scope of this product includes planning, research, development, integration and deployment, continuing customer/product support, and quality and reliability activities, as well as industrial and academic collaborations. Projects and technologies include tools for optimized problem set-up and meshing, metadata and scientific data management, and application-specific and general-purpose visualization, analysis, and comparison. Research includes innovative data access methods and visualization of massive, complex data. Special focus will be placed on tools for improving end-user productivity. Also included are procurement, deployment, and support of office and collaborative space visualization displays, mechanisms for image data delivery, and custom graphics rendering hardware.

Pre- and Post-Processing Environments Deliverables for FY08

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

WBS 1.5.5: Facility Operations and User Support

This sub-program provides both necessary physical facility and operational support for reliable production computing and storage environments as well as a suite of user services for effective use of ASC tri-lab computing resources. The scope of the facility operations includes planning, integration and deployment, continuing product support, software license and maintenance fees, procurement of operational equipment and media, quality and reliability activities, and collaborations. FOUS also covers physical space, power and other utility infrastructure, and LAN/WAN networking for local and remote access, as well as requisite system administration, cyber-security, and operations services for ongoing support and addressing system problems. Industrial and academic collaborations are an important part of this sub-program.

WBS 1.5.5.1: Facilities, Operations, and Communications

This level 4 product provides necessary physical facility and operational support for reliable production computing and storage environments. The scope of this product

includes planning, integration and deployment, continuing product support, software license and maintenance fees, procurement of operational equipment and media, quality and reliability activities and collaborations. This product also covers physical space, power and other utility infrastructure, and LAN/WAN networking for local and remote access, as well as requisite system administration, cyber-security and operations services for ongoing support and addressing system problems.

Facilities, Operations, and Communications Deliverables for FY08

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

WBS 1.5.5.2: User Support Services

This level 4 product provides users with a suite of services enabling effective use of ASC tri-lab computing resources. The scope of this product includes planning, development, integration and deployment, continuing product support, and quality and reliability activities collaborations. Projects and technologies include computer center hotline and help-desk services, account management, web-based system documentation, system status information tools, user training, trouble-ticketing systems, and application analyst support.

User Support Services Deliverables for FY08

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

WBS 1.5.5.3: Collaborations

This level 4 product provides collaboration with external agencies on specific high-performance computing projects. The scope of this product includes planning, development, integration and deployment, continuing product support, and quality and reliability activities collaborations. This product also includes any programmatic support across the entire ASC program and studies, either by internal or external groups, that enable the program to improve its planning and execution of its mission.

Collaborations Deliverables for FY08

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

V. ASC Level 1 and 2 Milestones

Table V-1. Quick Look: *Proposed* Level 1 Milestone Dependencies

Milestone ID	Milestone Title	Level	FY	Completion Date	DOE Program/Subprogram(s)	Site(s)	ASC Category	Depends on another Milestone	Milestone ID	Has another Milestone depending on it	Milestone ID
359	Complete modern baseline of all enduring stockpile systems with ASC codes.	1	2009	Sep-09	ASC	HQ, LLNL, LANL, SNL	DSW Deliverables		349		
1	Develop, implement, and apply a suite of physics-based models and high-fidelity databases to enable predictive simulation of the initial conditions for secondary performance.	1	FY09	Q4	ASC	HQ, LLNL, LANL, SNL	C11, C4				
2	Develop, implement, and validate a suite of physics-based models and high-fidelity databases in support of Full Operational Capability in DTRA's National Technical Nuclear Forensics program.	1	FY09	Q4	ASC	HQ, LLNL, LANL	C11, C1, C4, NA-22, DTRA				
3	Baseline demonstration of UQ aggregation methodology for full-system weapon performance prediction	1	FY10	Q4	ASC	HQ, LLNL, LANL, SNL	C11, C1, C4, DSW				
4	Develop, implement, and apply a suite of physics-based models and high-fidelity databases to enable predictive simulation of the initial conditions for primary boost.	1	FY12	Q4	ASC	HQ, LLNL, LANL	C11, C1, C2				

Milestone ID	Milestone Title	Level	FY	Completion Date	DOE Program/Subprogram(s)	Site(s)	ASC Category	Depends on another Milestone	Milestone ID	Has another Milestone depending on it	Milestone ID
5	Capabilities for SFI response improvements	1	FY13	Q4	ASC	HQ, LLNL, LANL, SNL	C11, DSW				
6	Develop, implement, and apply a suite of physics-based models and high-fidelity databases to enable predictive simulation of primary boost	1	FY15	Q4	ASC	HQ, LLNL, LANL	C11, C1, C2, C10				
7	Develop predictive capability for full-system integrated weapon safety assessment	1	FY16	Q4	ASC	HQ, LLNL, LANL, SNL	C11, C1, C2, DSW				
8	Develop, implement, and apply a suite of physics-based models and high-fidelity databases to enable predictive simulation of secondary performance	1	FY20	Q4	ASC	HQ, LLNL, LANL, SNL	C11, C4, C2, C10				

Table V-2. Quick Look: Level 2 Milestone Dependencies for FY08[6]

Milestone ID	Milestone Title	Level	FY	Completion Date	DOE Program/Subprogram(s)	Site(s)	ASC Category	Depends on another Milestone	Milestone ID	Has another Milestone depending on it	Milestone ID
	Deliver a physics-based sub-grid model to support energy balance resolution	2	08	Mar-08	ASC/Integrated Codes	LLNL					
	Demonstrate progress toward ALE/AMR hydrodynamic capability	2	08	Mar-08	ASC/Integrated Codes	LLNL					
	Evaluate opportunities for sharing of modules across ASC codes	2	08	Jun-08	ASC/Integrated Codes	LLNL					
	Assess adequacy of current models for the initial conditions for boost	2	08	Sep-08	ASC/Integrated Codes	LLNL					
	Explore and assess opportunities to enhance the nuclear weapon simulation capability of performance code for future stockpile activities	2	08	Sep-08	ASC/Integrated Codes	LLNL					
	Develop enhanced capabilities in a multi-dimensional (1D, 2D, and 3D) effects code to support current and planned effects modeling efforts	2	08	Sep-08	ASC/Integrated Codes	LLNL					
	Improve physics models to address known deficiencies and facilitate the expansion of our nuclear forensic database to include emplacement scenarios	2	08	Sep-08	ASC/Integrated Codes	LLNL					

[6] Factors such as FY08 Congressional Appropriations, NNSA/DP directives, and National Security considerations may necessitate a change in the current milestone set.

Milestone ID	Milestone Title	Level	FY	Completion Date	DOE Program/Subprogram(s)	Site(s)	ASC Category	Depends on another Milestone	Milestone ID	Has another Milestone depending on it	Milestone ID
	Enhance the capabilities and extend the advanced multi-scale material strength model to another relevant material	2	08	Sep-08	ASC/Physics and Engineering Models	LLNL					
	New baseline global EOS data library delivered for QMU, V&V, and other applications	2	08	Sep-08	ASC/Physics and Engineering Models	LLNL					
	Advanced EOS tables for NIF ICF capsule materials delivered for capsule design, QMU, and V&V	2	08	Sep-08	ASC/Physics and Engineering Models	LLNL					
	Assessment of nuclear physics uncertainties	2	08	Sep-08	ASC/Physics and Engineering Models	LLNL					
	Use of the UQ methodology to provide predictive capability in off-normal situations	2	08	Sep-08	ASC/Verification & Validation						
	Validation of energy balance model	2	08	Sep-08	ASC/Verification & Validation						
	Contractor software quality assurance audit of ASC codes	2	08	Sep-08	ASC/Verification & Validation						
	Estimated ranges of adjustable parameters in an ASC code (40%)	2	08	Sep-08	ASC/Verification & Validation						
	PMP set expanded to 25 events	2	08	Sep-08	ASC/Verification & Validation						
	Deploy Moab resource management services on BG/L	2	08	Jun-08	Computational Systems & Software Environment, Facility Operations & User Support	LLNL					
	Deploy identity/account management automation tools	2	08	Sep-08	Computational Systems & Software Environment, Facility Operations & User Support	LLNL					

Milestone ID	Milestone Title	Level	FY	Completion Date	DOE Program/Subprogram(s)	Site(s)	ASC Category	Depends on another Milestone	Milestone ID	Has another Milestone depending on it	Milestone ID
	Update and document Software Life Cycle Plan for the LANL ASC modern multi-physics code projects	2	08	Dec-07	ASC/Integrated Codes	LANL					
	Release of a Crestone project code to support X Program requirements, attribution, TBI and Campaign 4	2	08	Mar-08	ASC/Integrated Codes	LANL					
	Release of a Shavano project code to support X Program requirements, attribution, TBI and Campaign 4	2	08	Mar-08	ASC/Integrated Codes	LANL					
	High-fidelity simulation of a lighting system using a Crestone project code	2	08	Sep-08	ASC/Integrated Codes	LANL					
	Release of a Crestone project code to support high fidelity simulations of a lighting system	2	08	Sep-08	ASC/Integrated Codes	LANL					
	Release of a Shavano project code to support X Program requirements, attribution, TBI and dynamic plutonium experiments	2	08	Sep-08	ASC/Integrated Codes	LANL					
	Enhanced Pu multiphase EOS capability	2	08	Jun-08	ASC/Physics & Engineering Models	LANL					
	Develop, benchmark, and compare stand-alone NLTE opacity capabilities	2	08	Jun-08	ASC/Physics & Engineering Models	LANL					
	Fundamental simulations of material response (MD code) and plasma physics (PIC code) on HPC platforms in support of resolving one of the "knobs"	2	08	Sep-08	ASC/Physics & Engineering Models	LANL					

Milestone ID	Milestone Title	Level	FY	Completion Date	DOE Program/Subprogram(s)	Site(s)	ASC Category	Depends on another Milestone	Milestone ID	Has another Milestone depending on it	Milestone ID
	ASC simulations supporting the National technical Nuclear Forensics attribution program	2	08	Sep-08	ASC/Physics & Engineering Models	LANL					
	Physics enhancements to ductile damage/failure framework to account for 3D expansion deformation	2	08	Sep-08	ASC/Physics & Engineering Models	LANL					
	V&V assessment of ASC codes for thermonuclear applications, including initial definition of secondary validation test suite	2	08	Dec-07	ASC/Verification & Validation	LANL					
	V&V assessment of late-time primary implosion	2	08	Sep-08	ASC/Verification & Validation	LANL					
	Demonstrate RR base initial design meets production computing requirements as set forth in requirements document	2	08	Sep-08	ASC/Computational Systems & Software Environment	LANL					
	Complete an assessment of the RoadRunner final system	2	08	Dec-07	ASC/Computational Systems & Software Environment	LANL					
	Infrastructure plan for petascale computing environment	2	08	Mar-08	ASC/Computational Systems & Software Environment	LANL					
	Take delivery of Roadrunner phase 3 and demonstrate heterogeneous computing	2	08	Sep-08	ASC/Facility Operations & User Support	LANL					
	Predictive failure capabilities in SIERRA mechanics	2	08	Sep-08	ASC/Integrated Codes	SNL					
	Improved energy dissipation models for predictive mechanical response	2	08	Sep-08	ASC/Integrated Codes	SNL					
	Neutron tube source plasma generation and transport	2	08	Sep-08	ASC/Integrated Codes	SNL					

Milestone ID	Milestone Title	Level	FY	Completion Date	DOE Program/Subprogram(s)	Site(s)	ASC Category	Depends on another Milestone	Milestone ID	Has another Milestone depending on it	Milestone ID
	Algorithms for system-level uncertainty assessment	2	08	Sep-08	ASC/Integrated Codes	SNL					
	Deploy implicit contact enforcement in ACME	2	08	Sep-08	ASC/Integrated Codes	SNL					
	Aged temperature/radiation aware model of complimentary metal oxide semiconductor (CMOS) integrated circuit technology	2	08	Sep-08	ASC/Physics & Engineering Models	SNL					
	Initial model demonstration for general component foam encapsulation processing	2	08	Sep-08	ASC/Physics & Engineering Models	SNL					
	ALEGRA-HEDP Validation for Z-pinch implosion applications	2	08	Sep-08	ASC/Verification & Validation	SNL					
	Initial demonstration of QMU for cable SGEMP	2	08	Sep-08	ASC/Verification & Validation	SNL					
	Uncertainty quantification application demonstration of design-through-analysis environment	2	08	Sep-08	ASC/Computational Systems & Software Environment	SNL					
	Deliver post-processing tools that enable verification and validation of FY08 HEDP simulations	2	08	Sep-08	ASC/Computational Systems & Software Environment	SNL					
	CAD-mesh integration	2	08	Sep-08	ASC/Computational Systems & Software Environment	SNL					
	Red Storm 500 teraFLOPS upgrade	2	08	Jun-08	ASC/Computational Systems & Software Environment, Facility Operations & User Support	SNL					
	TLCC installation and operations	2	08	Sep-08	ASC/Facility Operations & User Support	SNL					

Milestone ID	Milestone Title	Level	FY	Completion Date	DOE Program/Subprogram(s)	Site(s)	ASC Category	Depends on another Milestone	Milestone ID	Has another Milestone depending on it	Milestone ID
	TLCC hardware delivery and acceptance at LLNL	2	08	Mar-08	ASC/Computational Systems & Software Environment, Facility Operations & User Support	LLNL, LANL, SNL					
	Infrastructure deployment plan for ASC petascale environments	2	08	Mar-08	ASC/Computational Systems & Software Environment, Facility Operations & User Support	LLNL, LANL, SNL					
	Deploy Tripod capabilities for ASC capacity computing environment	2	08	Jun-08	ASC/Computational Systems & Software Environment, Facility Operations & User Support	LLNL, LANL, SNL					

Table V-3. Quick Look: *Preliminary* Level 2 Milestone Dependencies for FY09

Milestone ID	Milestone Title	Level	FY	Completion Date	DOE Program/Subprogram(s)	Site(s)	ASC Category	Depends on another Milestone	Milestone ID	Has another Milestone depending on it	Milestone ID
	Deliver improved AGEX capabilities to users	2	09		ASC/Integrated Codes	LLNL					
	Improve physics models and nuclear databases in support of nuclear forensic full operational capability	2	09		ASC/Integrated Codes	LLNL					
	Explore and assess required improvements in numerical treatments of materials failure and fracture	2	09		ASC/Integrated Codes	LLNL					
	Advanced model of HE initiation and failure	2	09		ASC/Physics & Engineering Models	LLNL					
	Advanced radiative properties model	2	09		ASC/Physics & Engineering Models	LLNL					
	Next generation hydrodynamic model	2	09		ASC/Physics & Engineering Models	LLNL					
	Multi-scale material strength model with applications	2	09		ASC/Physics & Engineering Models	LLNL					
	Standard calculation 2009 (SC09)	2	09		ASC/Verification & Validation	LLNL					
	Estimated ranges of adjustable parameters in an ASC code (80%)	2	09		ASC/Verification & Validation	LLNL					
	Production Deployment of HPSS Release 7.1	2	09		ASC/Computational Systems & Software Environment	LLNL					
	Application code correctness tool suite for 10,000 or more nodes	2	09		ASC/Computational Systems & Software Environment	LLNL					

Milestone ID	Milestone Title	Level	FY	Completion Date	DOE Program/Subprogram(s)	Site(s)	ASC Category	Depends on another Milestone	Milestone ID	Has another Milestone depending on it	Milestone ID
	Sequoia ID and Phase One I/O infrastructure initial deployment	2	09		ASC/Computational Systems & Software Environment	LLNL					
	Preliminary constitutive framework for representation of certain material	2	09		ASC/Physics & Material Models	LANL					
	Documentation of current reactive burn models and evaluation against a validation test suite	2	09		ASC/Physics & Material Models	LANL					
	Advances in our nuclear databases for Pu fission cross section and fission neutron spectra, for supporting a knob-resolution	2	09		ASC/Physics & Material Models	LANL					
	Validation assessment of penetration mechanics for surety applications	2	09		ASC/Verification & Validation	LANL					
	Catalog of Major Adjustable Parameters in Weapons Physics Simulations	2	09		ASC/Verification & Validation	LANL					
	Demonstrate a scientific application that uses a significant portion of the hybrid RoadRunner system's capabilities	2	09		ASC/Facility Operations & User Support	LANL					
	Coupled thermal structural capability in SIERRA mechanics to model structural collapse during a fire	2	09		ASC/Integrated Codes	SNL					
	Initial SIERRA mechanics capability of coupled PREMO/CALORE ablation capability for reentry environments	2	09		ASC/Integrated Codes	SNL					

Milestone ID	Milestone Title	Level	FY	Completion Date	DOE Program/Subprogram(s)	Site(s)	ASC Category	Depends on another Milestone	Milestone ID	Has another Milestone depending on it	Milestone ID
	Error control and optimization for transient mechanics	2	09		ASC/Integrated Codes	SNL					
	Scalable solvers and pre-conditioners for intrusive UQ	2	09		ASC/Integrated Codes	SNL					
	Improved pressure fluctuation model for turbulent flow	2	09		ASC/Physics & Material Models	SNL					
	Initial validation of weapon safety models for abnormal mechanical environments	2	09		ASC/Verification & Validation	SNL					
	Advanced memory subsystems	2	09		ASC/Computational Systems & Software Environment	SNL					
	Smart simulation/experimental petascale data comparison tools	2	09		ASC/Computational Systems & Software Environment	SNL					
	Evaluation of the impact chip multiprocessors have on Sandia application performance	2	09		ASC/Computational Systems & Software Environment	SNL					
	Deploy Tripod capabilities for capacity computing environment	2	09		ASC/Facility Operations & User Support	LLNL, LANL, SNL					
	TLCC installation and operations	2	09		ASC/Facility Operations & User Support	LLNL, LANL, SNL					

Detailed Milestone Descriptions for FY08

Further milestone descriptions will be added in Rev. 0.1 of this document.

Milestone (ID#): Deliver a physics-based sub-grid model to support energy balance resolution
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Mar-08
ASC nWBS Subprogram: Integrated Codes
Participating Sites: LLNL
Participating Programs/Campaigns: ASC
Description:

Milestone (ID#): Demonstrate progress toward ALE/AMR hydrodynamic capability
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Mar-08
ASC nWBS Subprogram: Integrated Codes
Participating Sites: LLNL
Participating Programs/Campaigns: ASC
Description:

Milestone (ID#): Evaluate opportunities for sharing of modules across ASC codes
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Jun-08
ASC nWBS Subprogram: Integrated Codes
Participating Sites: LLNL
Participating Programs/Campaigns: ASC
Description:

Milestone (ID#): Assess adequacy of current models for the initial conditions for boost
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Jun-08
ASC nWBS Subprogram: Integrated Codes
Participating Sites: LLNL
Participating Programs/Campaigns: ASC
Description:

Milestone (ID#): Explore and assess opportunities to enhance the nuclear weapon simulation capability of performance code for future stockpile activities
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Integrated Codes
Participating Sites: LLNL
Participating Programs/Campaigns: ASC
Description:

Milestone (ID#): Develop enhanced capabilities in a multi-dimensional (1D, 2D, and 3D) effects code to support current and planned effects modeling efforts
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Integrated Codes
Participating Sites: LLNL
Participating Programs/Campaigns: ASC
Description:

Milestone (ID#): Improve physics models to address known deficiencies and facilitate the expansion of our nuclear forensic database to include emplacement scenarios
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Integrated Codes
Participating Sites: LLNL
Participating Programs/Campaigns: ASC
Description:

Milestone (ID#): Enhance the capabilities and extend the advanced multi-scale material strength model to another relevant material
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Physics & Engineering Models
Participating Sites: LLNL
Participating Programs/Campaigns: ASC
Description:

Milestone (ID#): New baseline global EOS data library delivered for QMU, V&V, and other applications
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Physics & Engineering Models
Participating Sites: LLNL
Participating Programs/Campaigns: ASC
Description:

Milestone (ID#): Advanced EOS tables for NIF ICF capsule materials delivered for capsule design, QMU, and V&V
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Physics & Engineering Models
Participating Sites: LLNL
Participating Programs/Campaigns: ASC
Description:

Milestone (ID#): Assessment of nuclear physics uncertainties
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Physics & Engineering Models
Participating Sites: LLNL
Participating Programs/Campaigns: ASC
Description:

Milestone (ID#): Use of the UQ methodology to provide predictive capability in off-normal situations
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Verification & Validation
Participating Sites: LLNL
Participating Programs/Campaigns: ASC
Description: This activity will involve the performance of a set of detailed calculations on a stockpile system and will attempt to apply advanced UQ methods developed in A-Program to extrapolate performance into areas of off-normal conditions. The results of the UQ analysis will be applied to a particular off-normal situation where data is available.

Milestone (ID#): Validation of energy balance model
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Verification & Validation
Participating Sites: LLNL
Participating Programs/Campaigns: ASC
Description: This activity will involve the performance of a set of detailed calculations on the new energy balance model associated with our nuclear design codes. The new model will be applied to a specific underground nuclear test of significance to the stockpile stewardship program. Sensitivities of the model will be examined and compared to the actual experimental data.

Milestone (ID#): Contractor software quality assurance audit of ASC codes
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Verification & Validation
Participating Sites: LLNL
Participating Programs/Campaigns: ASC
Description: The ASC V&V SQE project plans to conduct a contractor audit of the ASC codes between May- June of 2008. Five auditors will be selected to conduct the audit. The audit will measure compliance between the ASC software development requirements and practices and QC-1 Rev 10 and the LLNL Institutional Software Quality Assurance Program. The audit will follow the guidelines of the American Society for Quality (ASQ) and the IEEE. The audit will include an Audit Plan created by the auditors and will be reviewed by LLNL prior to the on-site visit. The Audit Plan will select the codes to be audited. An outline and questionnaire will be sent 20 business days ahead of the auditors' on-site visit. ASC documentation and questionnaire answers will be provided10 business days prior to the auditors visit. An In-brief will be conducted by the auditors discussing the Audit Plan for the week. An overview briefing will be conducted by LLNL that discusses the ASC V&V SQE program. Point of contact for the software audit will be the Project Lead for the ASC V&V SQE or their designee. The on-site audit will consist of sets of interviews between auditors and ASC management, scientists, developers, and SQE staff conducted for a one week period. An Out-brief will be conducted at the end of the interviews summarizing the auditor's observations and findings. A Draft Final Report will be submitted to LLNL ASC for technical review and factual review no later than 15 business days after the Out-brief. A Final Report will be submitted by the auditors no later than 15 days after receipt of the comments to the Draft Final Report.

Milestone (ID#): Estimated ranges of adjustable parameters in an ASC code (40%)
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Verification & Validation
Participating Sites: LLNL
Participating Programs/Campaigns: ASC
Description: This activity is a follow on to the FY07 L2 Milestone 2350 that sought to identify all the free (adjustable) parameters in an ASC code. Approximately 700 variables were identified that could influence the outcome of a calculation (although not all these variables are frequently adjusted by the users of the code. The second step is to identify the default values of the parameters and estimate the possible range that the variables can span. This L2 Milestone will accomplish that effort for 40% of currently reported parameters. Subsequent L2 Milestones in FY09 and FY10 will complete the effort. The ranges of the adjustable parameters will be the basis for sensitivity studies on code outputs.

Milestone (ID#): PMP set expanded to 25 events
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Verification & Validation
Participating Sites: LLNL
Participating Programs/Campaigns: ASC
Description: This activity is a continuation of the Primary Metrics Project and represents an expansion of the formal Configuration Managed set of Underground Nuclear Tests to 25 events. This new expansion will address new events relevant to RRW certification and events relevant to the problem of attribution.

Milestone (ID#): Deploy Moab resource management services on BG/L
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Computational Systems & Software Environment, Facility Operations & User Support
Participating Sites: LLNL
Participating Programs/Campaigns: ASC
Description: In September 2006, the Moab Workload Manager was selected to become the standard batch scheduling system for exclusive use across the Tri-Lab HPC facilities. Moab is a commercial product that is developed and sold by Cluster Resources, Inc. LLNL's existing batch system, LCRM, will gradually be replaced by Moab on all platforms. Moab workload management services were installed on several LLNL platforms in early FY07. The BG/L system currently runs the SLURM resource manager and is scheduled by LCRM. This milestone represents LLNL efforts to enhance both SLURM and Moab to extend Moab's capabilities to schedule and manage BG/L.

Milestone (ID#): Deploy identity/account management automation tools
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Computational Systems & Software Environment, Facility Operations & User Support
Participating Sites: LLNL
Participating Programs/Campaigns: ASC
Description: The LC LLNL HPC Identity and Account management system will replace the paper system used by users to request accounts, and replace current backend systems (IAM and LCAMS), currently used to process the requests, with a Web-based system. This deliverable will produce a flexible Identity Management system that can streamline the account request, approval and instantiation process, while simultaneously improving security, and reducing costs associated with this activity. This milestone deliverable will interface with the LLNL Institutional Identity Management system to leverage data held by them relating to physical site access, employment status and remote access. While, some components are expected to be deployed in Q1 and Q2 full functionality for a majority of LC users should be attained in Q3 to complete the milestone.

Milestone (ID#): Update and document Software Life Cycle Plan for the LANL ASC modern multi-physics code projects
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Dec-07
ASC nWBS Subprogram: Integrated Codes
Participating Sites: LANL
Participating Programs/Campaigns: ASC
Description:

Milestone (ID#): Release of a Crestone project code to support X Program requirements, attribution, TBI and Campaign 4
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Mar-08
ASC nWBS Subprogram: Integrated Codes
Participating Sites: LANL
Participating Programs/Campaigns: ASC
Description:

Milestone (ID#): Release of a Shavano project code to support X Program requirements, attribution, TBI and Campaign 4
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Mar-08
ASC nWBS Subprogram: Integrated Codes
Participating Sites: LANL
Participating Programs/Campaigns: ASC
Description:

Milestone (ID#): High-fidelity simulation of a lighting system using a Crestone project code
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Integrated Codes
Participating Sites: LANL
Participating Programs/Campaigns: ASC
Description:

Milestone (ID#): Release of a Crestone project code to support high fidelity simulations of a lighting system
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Integrated Codes
Participating Sites: LANL
Participating Programs/Campaigns: ASC
Description:

Milestone (ID#): Release of a Shavano project code to support X Program requirements, attribution, TBI and dynamic plutonium experiments
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Integrated Codes
Participating Sites: LANL
Participating Programs/Campaigns: ASC
Description:

Milestone (ID#): Enhanced Pu multiphase EOS capability
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Jun-08
ASC nWBS Subprogram: Physics & Engineering Models
Participating Sites: LANL
Participating Programs/Campaigns: ASC
Description: This milestone will set goals for the advancement of our multiphase capability that is now being established. It will refine the initial capability we now have in place to take advantage of new experimental data that is being measured as part of the Pu Strategy and the DPE program, as well as advances in our theoretical predictive capability in EOS materials research and phase transition research.

Milestone (ID#): Develop, benchmark, and compare stand-alone NLTE opacity capabilities
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Jun-08
ASC nWBS Subprogram: Physics & Engineering Models
Participating Sites: LANL
Participating Programs/Campaigns: ASC
Description: Non LTE opacities are important in various applications. This milestone will lead to a report with recommendation on technical path forward for in-line NLTE capability for our codes.

Milestone (ID#): Fundamental simulations of material response (MD code) and plasma physics (PIC code) on HPC platforms in support of resolving one of the "knobs"
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Physics & Engineering Models
Participating Sites: LANL
Participating Programs/Campaigns: ASC
Description: We are developing our MD simulation code to model various aspects of material response and instabilities, and our PIC code to model plasma phenomenon. This will advance our understanding of the microscopical physics that is needed for removing reliance on the present ad-hoc "knob" treatment. The work will involve porting our codes to various HPC platforms, including simulations on Roadrunner.

Milestone (ID#): ASC simulations supporting the National technical Nuclear Forensics attribution program
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Physics & Engineering Models
Participating Sites: LANL
Participating Programs/Campaigns: ASC
Description: This work continues the ASC effort in partnership with DTRA (and Livermore) initiated in FY07. It will advance the ASC simulation capability that is needed to support of DTRA's Full Operational capability (FOC) in 2009. The work involves simulation code methods development, physical model and database research, and V&V.

Milestone (ID#): Physics enhancements to ductile damage/failure framework to account for 3D expansion deformation
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Physics & Engineering Models
Participating Sites: LANL
Participating Programs/Campaigns: ASC
Description: This will continue the development of our strength and damage modeling capability needed for various applications.

Milestone (ID#): V&V assessment of ASC codes for thermonuclear applications, including initial definition of secondary validation test suite
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Dec-07
ASC nWBS Subprogram: Verification & Validation
Participating Sites: LANL
Participating Programs/Campaigns: ASC
Description: Complete a quantitative verification and validation assessment of specific ASC codes as applied to Thermonuclear Applications. To include verification assessment, component validation, integral validation, uncertainty quantification, and delivery of benchmark test problems to the appropriate ASC code teams. Also deliver the initial definition of the LANL secondary validation test suite.

Milestone (ID#): V&V assessment of late-time primary implosion
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Verification & Validation
Participating Sites: LANL
Participating Programs/Campaigns: ASC
Description: Complete a quantitative verification and validation assessment of specific ASC codes as applied to Late-time Primary Implosion. To include verification assessment, component validation, integral validation, uncertainty quantification, and delivery of benchmark test problems to the appropriate ASC code teams. Also included will be an updated version of the LANL primary validation test suite.

Milestone (ID#): Demonstrate RR base initial design meets production computing requirements as set forth in requirements document
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Computational Systems & Software Environment
Participating Sites: LANL
Participating Programs/Campaigns: ASC
Description: The Crestone, Shavano, and Silverton projects have each specified problem input decks and the required application configuration necessary to run these problem input decks for the milestone.

Milestone (ID#): Complete an assessment of the RoadRunner final system
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Dec-07
ASC nWBS Subprogram: Computational Systems & Software Environment
Participating Sites: LANL
Participating Programs/Campaigns: ASC
Description:

Milestone (ID#): Infrastructure plan for petascale computing environment
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Mar-08
ASC nWBS Subprogram: Computational Systems & Software Environment
Participating Sites: LANL
Participating Programs/Campaigns: ASC
Description: The tri-labs will produce a detailed requirements analysis and deployment plan for preparation of the ASC computing environment to host petascale computing system(s).

Milestone (ID#): Take delivery of Roadrunner phase 3 and demonstrate heterogeneous computing
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Facility Operations & User Support
Participating Sites: LANL
Participating Programs/Campaigns: ASC
Description: Take delivery of Roadrunner phase 3 System and demonstrate heterogeneous computing.

Milestone (ID#): Predictive failure capabilities in SIERRA mechanics
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Integrated Codes
Participating Sites: SNL
Participating Programs/Campaigns: ASC
Description: Initial demonstration of predictive failure capabilities in SIERRA mechanics. Demonstrate multiple approaches to failure prediction in SIERRA mechanics, both in quasistatics and explicit dynamics, that could include multi-length-scale approaches, element to particle conversions, arbitrary polyhedral element failure, or peridynamics. These merits of various approaches will be demonstrated on applications relevant to assured safety.

Milestone (ID#): Improved energy dissipation models for predictive mechanical response
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Integrated Codes
Participating Sites: SNL
Participating Programs/Campaigns: ASC
Description: Demonstration of improved energy dissipation models for predictive mechanical response in determining component specifications from system level environmental loads. Energy dissipation models that are more predictive that the Iwan models currently in use will be implemented in the SIERRA mechanics structural dynamics module (SALINAS) and demonstrated on applications pertinent to reentry and nuclear survivability applications.

Milestone (ID#): Neutron tube source plasma generation and transport
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Integrated Codes
Participating Sites: SNL
Participating Programs/Campaigns: ASC
Description: Initial demonstration of neutron tube source plasma generation and transport. This is an initial demonstration that the approach to simulating plasma generation and transport in neutron tubes is viable. This supports the neutron generator focus area.

Milestone (ID#): Algorithms for system-level uncertainty assessment
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Integrated Codes
Participating Sites: SNL
Participating Programs/Campaigns: ASC
Description: This milestone will focus on new algorithms for performing UQ/QMU aggregation, building on (and modernizing) capabilities for event tree and fault tree system analysis, which have limiting assumptions in terms of component assessment independence. The new methodology will build on decomposition ideas from system-level multidisciplinary optimization to incorporate component assessment couplings, and will allow aggregation of data from heterogeneous assessment sources. Initial application of these methods will be demonstrated for RRW-1, as enabled by efforts in a related DART/Algorithms L2 milestone.

Milestone (ID#): Deploy implicit contact enforcement in ACME
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Integrated Codes
Participating Sites: SNL
Participating Programs/Campaigns: ASC
Description: This milestone will focus the development and implementation of an implicit contact enforcement capability in ACME. This will nicely compliment the existing explicit contact enforcement capability already in ACME and broaden ACME application space to include such ASC applications as Adagio for quasi-static structural mechanics and Aria for fluid/solid interactions. This will be demonstrated in Adagio with the goal of positively affecting Adagio's core contact capabilities. A neutron generator component manufacturing problem will be chosen to demonstrate this capability.

Milestone (ID#): Aged temperature/radiation aware model of complimentary metal oxide semiconductor (CMOS) integrated circuit technology
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Physics & Engineering Models
Participating Sites: SNL
Participating Programs/Campaigns: ASC
Description: Weapon systems were originally qualified for a 20 to 30 year life span. SNL stockpile system owners are being asked to re-qualify their weapon systems for an additional 20 to 30 years. Therefore, the electrical circuit performance of aged weapon systems in a hostile environment is a major concern. To aid in confidence levels of stockpile system reliability, we propose to develop an aged temperature/radiation aware (STS levels) environment model of Complimentary Metal Oxide Semiconductor (CMOS) Integrated circuit technology (circa 1980) which is applicable to W88, W80, B83 and B61 weapon subsystems. This milestone will improve the physics base of a previously developed model for double-diffused MOS technology that includes total dose and aging effects.

Milestone (ID#): Initial model demonstration for general component foam encapsulation processing
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Physics & Engineering Models
Participating Sites: SNL
Participating Programs/Campaigns: ASC
Description: Development and initial demonstration of foam filling manufacturing model for an idealized firing set geometry. Model will account for variable density and thermal effects and be compared with experimental data where available.

Milestone (ID#): ALEGRA-HEDP Validation for Z-pinch implosion applications
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Verification & Validation
Participating Sites: SNL
Participating Programs/Campaigns: ASC
Description: This milestone quantifies uncertainties and prediction accuracy margins in ALEGRA-HEDP low density MHD z-pinch implosions. An understanding of uncertainty and predictive capability of these ALEGRA-HEDP simulations is required for their application to predictive experimental design support for the refurbished Z machine.

Milestone (ID#): Initial demonstration of QMU for cable SGEMP
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Verification & Validation
Participating Sites: SNL
Participating Programs/Campaigns: ASC
Description: First ever demonstration of QMU for Cable SGEMP with RRW1 as a target application.

Milestone (ID#): Uncertainty quantification application demonstration of design-through-analysis environment
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Computational Systems & Software Environment
Participating Sites: SNL
Participating Programs/Campaigns: ASC
Description: Using an automated workflow model, which includes both pre- and post-processing components of the DTA environment we will demonstrate an uncertainty quantification capability using a specific weapon system application. The workflow will manage parameterized ensembles of simulations to evaluate the effect of important uncertainties for that application, which will be associated with one of the DART pilot projects. The automated workflow model will enable analysts to create and manage families of parameterized simulations to support uncertainty quantification. In general, model parameters can include geometric dimensions, mesh parameters, material properties, boundary and initial conditions, and other model attributes. The workflow will automatically and systematically select the appropriate parameter combination for each run in the ensemble and will manage the collective runs to generate a statistical analysis of the results. This work will involve integration of additional tools into the DTA environment, and will require interoperation with the Dakota framework and possibly commercial packages for additional statistical analysis of the ensemble simulation results. This work requires substantial advances in our ability to automate individual tool execution and to manage their interoperation.

Milestone (ID#): Deliver post-processing tools that enable verification and validation of FY08 HEDP simulations
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Computational Systems & Software Environment
Participating Sites: SNL
Participating Programs/Campaigns: ASC
Description: Provide capabilities needed to support the FY08 V&V/HEDP milestone "Validation of Alegra/HEDP for Zpinch Implosion Applications."

Milestone (ID#): CAD-mesh integration
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Computational Systems & Software Environment
Participating Sites: SNL
Participating Programs/Campaigns: ASC
Description: One of the biggest bottlenecks in building models for simulation is cleaning up problems in the CAD model before a quality finite element mesh can be generated. This milestone will address this issue by providing a close coupling of the original CAD model with the meshing tools. Using the CUBIT Geometry and Meshing Toolkit, we will integrate closely with the Solidworks kernel, a widely used solid modeling tool throughout the weapons complex. We will develop geometry tolerant methods within Cubit that will take advantage of this close tie to the geometry. Building on tools developed in the FY07 ASC Level 2 milestone, automation algorithms for geometry cleanup and simplification will be applied directly within the meshing process. This will enable the user to quickly turn around a complex simulation by dramatically shortening the time to diagnose and correct problem geometry.

Milestone (ID#): Red Storm 500 teraFLOPS upgrade
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Jun-08
ASC nWBS Subprogram: Computational Systems & Software Environment, Facility Operations & User Support
Participating Sites: SNL
Participating Programs/Campaigns: ASC
Description: Sandia will upgrade the Red Storm computer system to a peak of ~500TF in FY'08. The 12,960 compute nodes will be upgraded to 2.4 GHz quad-core Opteron processors and the memory will be upgraded to 2 GB per core or 8 GB per node. The upgrade involves replacing all compute node boards, compute node processors and memory. Also, there will be upgrades to the power supplies and the system cooling. The existing cabinets, backplanes, interconnect, and cabling and the existing service and I/O nodes will be reused. The system will then have a 51,480 compute node cores with 101 TB of compute node memory.

Milestone (ID#): TLCC installation and operations
Level: 2

Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Sep-08
ASC nWBS Subprogram: Facility Operations & User Support
Participating Sites: SNL
Participating Programs/Campaigns: ASC
Description: Deploy common capacity platform at Sandia.

Milestone (ID#): TLCC hardware delivery and acceptance at LLNL
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Mar-08
ASC nWBS Subprogram: Computational Systems & Software Environment, Facility Operations & User Support
Participating Sites: LLNL, LANL, SNL
Participating Programs/Campaigns: ASC
Description: This milestone covers the selected vendor's TLCC delivery, system installation, assembly, initial functionality and performance verification testing, and turn over to LLNL for local TLCC acceptance testing. Acceptance testing will be considered complete when all cluster scalable units, switch and cabling hardware is installed, burned-in, and functional (i.e., all nodes, management Ethernet, and switch infrastructure must be functional), and LLNL confirms that CHAOS software stack is installed and running on the cluster. In addition, cluster on-site hardware maintenance parts cache is to be fully stocked, cluster must meet integration test entry criteria, acceptance testing is successfully executed, cluster successfully completes integration test exit criteria, and required vendor documentation approved.

Milestone (ID#): Infrastructure deployment plan for ASC petascale environments
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Mar-08
ASC nWBS Subprogram: Computational Systems & Software Environment, Facility Operations & User Support
Participating Sites: LLNL, LANL, SNL
Participating Programs/Campaigns: ASC
Description: The ASC Petascale Environment Infrastructure Deployment Plan will identify, assess, and specify the development and deployment approaches for critical components in four different technical areas: (1) development environment and tools; (2) petascale data analysis; (3) I/O, file systems and archives; and (4) networks and interconnects. The Plan will identify and quantify potential technical gaps or issues, and, where they exist, will define a prioritized approach to closing those gaps. The schedules for site-specific, Tri-Lab and/or inter-agency approaches to providing the necessary petascale infrastructures will be provided. While the specific deliverable (a planning document) for this milestone is to be completed in Q2 FY08, the infrastructure components will likely be deployed throughout a five-year FY08-FY12 timetable, and may be applicable to multiple ASC petascale platforms deployed during that time.

Milestone (ID#): Deploy Tripod capabilities for ASC capacity computing environment
Level: 2
Fiscal Year: FY08
DOE Area/Campaign: ASC
Completion Date: Jun-08
ASC nWBS Subprogram: Facility Operations & User Support
Participating Sites: LLNL, LANL, SNL
Participating Programs/Campaigns: ASC
Description: The tri labs will deploy the Tripod software stack on the ASC Tri-Laboratory Linux Capacity Cluster (TLCC) systems. The software stack components are to include: OS, communication libraries, compilers, application development tools, system management tools, user environment, etc. The tri-labs will continue to do gap and risk analyses of the Tripod software stack and develop a mitigation plan accordingly. Configuration management and change control processes will be developed as tools to manage the Tripod stack to remain consistent across the tri-labs.

Milestone Descriptions for Preliminary FY09

Preliminary milestone descriptions will be added in Rev. 0.1 of this document.

VI. ASC Roadmap Drivers for FY08–FY09

Table VI-1. ASC Roadmap Drivers fro FY08-09[7]

Focus Area 1. Address National Security Simulation Needs	
Capabilities for Focus Area 1 1.1 Deliver Simulation Capability for Nuclear Weapons Needs (2007–2009) 1.2 Deliver Simulation Technology for Broader National Security Needs (2007–2012) 1.3 Investigate and Understand Off-Normal System Performance and Failure/Anomaly Issues in the Test Database (2008–2013)	**Targets for Focus Area 1** 2008: National Code Strategy 2009: Modular Physics and Engineering Packages For National Weapons Codes
Focus Area 2. Establish a Validated Predictive Capability for Key Physical Phenomena	
Capabilities for Focus Area 1 Deliver A Program Plan and Establish A Collaborative Center to Achieve Predictive Physics Capability (2007–2008) Apply Theory, Simulations, Experimental Data, and Interim Model S to Confirm Dominant Physical Phenomena (2008–2009) Demonstrate Improved Physics Understanding Based On Relevant Experimental Results (2009–2013)	**Targets for Focus Area 1** 2007: Launch Thermonuclear Burn Initiative Collaboration 2008: Realistic Plutonium Aging Simulations 2009: Science-Based Replacement for Knob (Ad Hoc Model) #1
Focus Area 3. Quantify and Aggregate Uncertainties in Simulation Tools	
Capabilities for Focus Area 3 3.1 Establish and Prioritize the Parameters Matrix (2007–2008) 3.2 Establish National and Collaborative Forums to Develop Uncertainty Aggregation Methodologies and Benchmarks (2008–2009) 3.3 Deliver Uncertainty Aggregation for QMU Applications (2008–2014)	**Targets for Focus Area 3** 2008: National Verification & Validation Strategy 2008: Assessment of Major Simulation Uncertainties 2009: Shared Weapons Physical Databases

[7] The ASC Top Ten Risks table was originally published in the *ASC Program Plan FY05*.

Focus Area 4. Provide Mission-Responsive Computational Environments	
Capabilities for Focus Area 4	**Targets for Focus Area 4**
4.1 Deploy a Computational Environments For Uncertainty Quantification (UQ) Analyses (2007–2008) 4.2 Deploy Computational Environments and User Facilities for Weapon Science Studies and Other Capability Computing Needs (2008-2012)	2007: Initiate New National User Facility Model for Capability Supercomputing 2008: Seamless User Environments for Capacity Computing 2009: Petascale Computing

VII. ASC Risk Management

Risk management is a process for identifying and analyzing risks, executing mitigation and contingency planning to minimize potential consequences of identified risks, and monitoring and communicating up-to-date information about risk issues. Risk management is about identifying opportunities and avoiding losses. A "risk" is defined as (1) a future event, action, or condition that might prevent the successful execution of strategies or achievement of technical or business objectives, and (2) the risk exposure level, defined by the likelihood or probability that an event, action, or condition will occur, and the consequences, if that event, action, or condition does occur. Table VII-1 summarizes ASC's top ten risks, which are managed and tracked.

Table VII-1. ASC's Top Ten Risks[8]

No	Risk Description	Risk Assessment			Mitigation Approach
		Consequence	Likelihood	Risk Exposure	
1	Compute resources are insufficient to meet capacity and capability needs of designers, analysts, DSW, or other Campaigns.	High	High	HIGH	Integrate program planning with DSW and other Campaigns, to ensure requirements for computing are understood and appropriately set; maintain emphasis on platform strategy as a central element of the program; pursue plans for additional and cost-effective capacity platforms.
2	Designers, analysts, DSW, or other Campaign programs lack confidence in ASC codes or models for application to certification /qualification.	Very High	Low	MEDIUM	Maintain program emphasis on V&V; Integrate program planning with DSW and other Campaign programs to assure requirements needed for certification/qualification are properly set and met.

[8] The ASC Top Ten Risks table was originally published in the *ASC Program Plan FY05*.

No	Risk Description	Risk Assessment			Mitigation Approach
		Consequence	Likelihood	Risk Exposure	
3	Inability to respond effectively with Modeling & Simulation (M&S) capability and expertise in support of stockpile requirements – near or long term, planned or unplanned (SLEP, SFIs, etc.).	Very High	Low	MEDIUM	Integrate program planning, particularly technical investment priority, with DSW and other Campaign programs to ensure capability and expertise is developed in most appropriate areas; retain ability to apply legacy tools, codes, models.
4	Base of personnel with requisite skills, knowledge, and abilities erodes.	High	Low	MEDIUM	Maintain emphasis on "best and brightest" personnel base, with Institutes, Research Foundations, and University programs, as central feeder elements of the program.
5	Advanced material model development more difficult, takes longer than expected.	Moderate	High	MEDIUM	Increase support to physics research; pursue plans for additional computing capability for physics model development
6	Data not available for input to new physics models or for model validation.	High	Moderate	MEDIUM	Work with Science Campaigns to obtain needed data; propose relevant experiments.
7	Infrastructure resources are insufficient to meet designer, analyst, DSW, or other Campaign program needs.	High	Low	MEDIUM	Integrate program planning with DSW and other Campaigns, to ensure requirements for computing are understood and appropriately set; maintain emphasis on system view of infrastructure and PSE strategy, as central elements of the program.
8	External regulatory requirements delay program deliverables by diverting resources to extensive compliance-related activities	Moderate	Low	MEDIUM	Work with external regulatory bodies to assure that they understand NNSA's mission, ASC's mission, and the processes to set and align requirements and deliverables, consistent with applicable regulations.

No	Risk Description	Risk Assessment			Mitigation Approach
		Consequence	Likelihood	Risk Exposure	
9	Inadequate computational environment impedes development and use of advanced applications on ASC platforms.	Moderate	Very Low	LOW	Integrated planning between program elements to anticipate application requirements and prioritize software tools development and implementation.
10	Fundamental flaws discovered in numerical algorithms used in advanced applications require major changes to application development.	Moderate	Very Low	LOW	Anticipate or resolve algorithm issues through technical interactions on algorithm research through the Institutes, ASC Centers, and academia, and focus on test problem comparisons as part of software development process.

VIII. Performance Measures

Table VIII-1. ASC Performance Measures

ADVANCED SIMULATION AND COMPUTING (ASC) CAMPAIGN								
Goal: Provides leading edge, high-end simulation capabilities to meet weapons assessment and certification requirements, including weapon codes, weapon science, platforms, and computer facilities.								
INDICATOR	**ANNUAL TARGETS**							**ENDPOINT TARGET DATE**
	FY04	**FY05**	**FY06**	**FY07**	**FY08**	**FY09**	**FY10**	
Peer-reviewed progress in completing milestones, according to a schedule in the ASC Campaign Program Plan, in the development and implementation of improved models and methods into integrated weapon codes and deployment to their users (long-term output). Panel Criteria: (1) Delivery and implementation of validated models into code projects, and (2) Documented verification of approximations.	High Fidelity Primary Code	Initial baseline Primary Code	Initial validated simulation code for W76 and W80	W80 code baseline	Conduct modern baseline of all enduring stockpile systems	Complete modern baseline of all enduring stockpile systems	Quantify margins and uncertainties of modern baseline simulations	By 2015, accomplish full transition from legacy design codes to modern ASC codes with documented quantification of margins and uncertainties of simulation solutions.
Cumulative percentage of the 31 weapon system	32%	38%	51%	67%	87%	96%	100%	By 2010, analyze 100 percent of 31

ADVANCED SIMULATION AND COMPUTING (ASC) CAMPAIGN								
Goal: Provides leading edge, high-end simulation capabilities to meet weapons assessment and certification requirements, including weapon codes, weapon science, platforms, and computer facilities.								
INDICATOR	**ANNUAL TARGETS**							**ENDPOINT TARGET DATE**
	FY04	**FY05**	**FY06**	**FY07**	**FY08**	**FY09**	**FY10**	
components, primary/secondary/engineering system, analyzed using ASC codes, as part of annual assessments and certifications (long-term output).								weapon system components using ASC codes, as part of annual assessments and certifications (interim target).
The maximum individual platform computing capability delivered, measured in trillions of operations per second (teraflops) (long-term output).	40	100	200	200	200	350	350	BY 2009, deliver a maximum individual platform computing capability of 350 teraFLOPS.
Total capacity of ASC production platforms attained, measured in teraflops, taking into consideration procurements & retirements of systems (long-term output).	75	172	160	360	470	980	980	By 2009, attain a total production platform capacity of 980 teraFLOPS.

ADVANCED SIMULATION AND COMPUTING (ASC) CAMPAIGN								
Goal: Provides leading edge, high-end simulation capabilities to meet weapons assessment and certification requirements, including weapon codes, weapon science, platforms, and computer facilities.								
INDICATOR	**ANNUAL TARGETS**							**ENDPOINT TARGET DATE**
	FY04	**FY05**	**FY06**	**FY07**	**FY08**	**FY09**	**FY10**	
Average cost per teraflops of delivering, operating, and managing all SSP production systems in a given fiscal year (efficiency measure).	$8.15M	$5.7M	$3.99M	$2.79M	$1.96M	$1.37M	$0.96M	By 2010, attain an average cost of $0.96 M per teraflops of delivering, operating, and managing all SSP production systems.

Appendix A. Glossary

The Glossary will be added in Rev. 0.1 of this document.

Appendix B. Points of Contact

The Points of Contact will be added in Rev. 0.1 of this document.

Appendix C.
WBS 1.5.1.4-TRI-001 Alliance Support

Alliance Support will be added in Rev. 0.1 of this document.

California Institute of Technology, Center for Simulating Dynamic Response of Materials

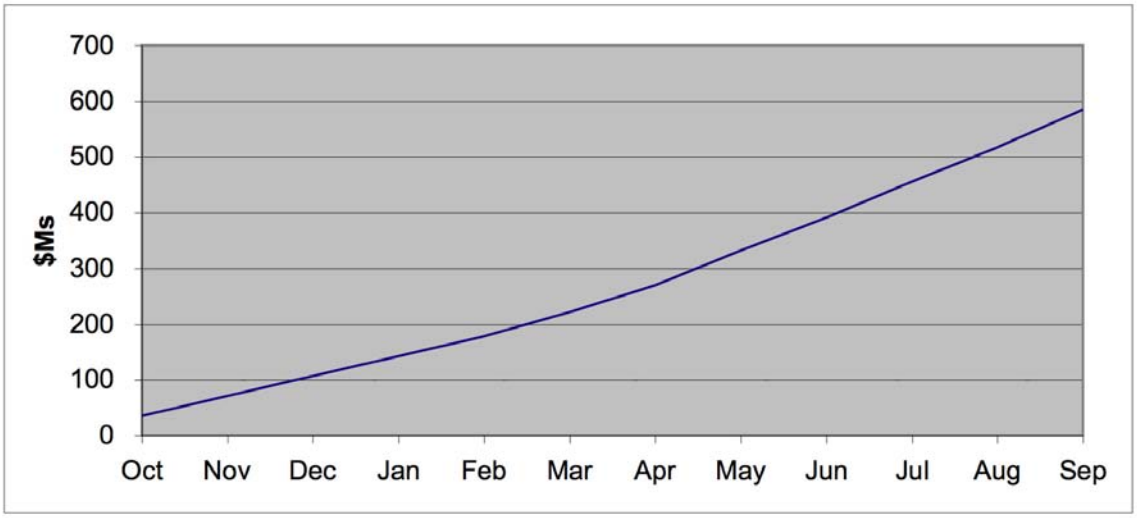
Stanford, ASC Alliance Center for Integrated Turbulence Simulations, CITS

University of Chicago, ASC Center for Astrophysical Thermonuclear Flashes

University of Illinois, Center for Simulation of Advanced Rockets

University of Utah, Center for Simulation of Accidental Fires and Explosions

Appendix D.
ASC Obligation/Cost Plan



Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
35.523	71.548	107.472	142.233	177.871	222.056	269.830	331.930	391.497	455.713	517.286	585.738

Figure D-1. ASC obligation/cost plan for FY08.

Appendix E.
ASC Performance Measurement Data for FY08

Table E-1. ASC Performance Measurement Data for FY08

ADVANCED SIMULATION AND COMPUTING (ASC) CAMPAIGN								
Goal: Provide the computational science and computer simulation tools necessary for understanding various behaviors and effects of nuclear weapons for responsive application to a diverse stockpile and scenarios of national security.								
INDICATOR	**ANNUAL TARGETS**							**ENDPOINT TARGET DATE**
	FY07	**FY08**	**FY09**	**FY10**	**FY11**	**FY12**	**FY13**	
CODE PREDICTIVITY: Biennial progress toward a desired end-state through a series of incremental targets of code usability and reliability for ASC applications as measured by the Code Maturity Index.	Baseline	TBD	TBD	TBD	TBD	TBD	TBD	By 2015, achieve 100% of target code maturity as assessed using the ASC Code Predictivity Characteristic Matrix and measured by the Code Maturity Index.
STOCKPILE IMPACT: The cumulative percentage of high consequence stockpile activities to which the modern ASC codes are the predominant simulation tools as measured by the national Stockpile Application Index (nSAI).	Baseline	55%	65%	77%	88%	100%	100%	By 2012, designers and analysts will use ASC codes predominately in 100% of the defined list of high consequence stockpile activities as measured by the nSAI.

ADVANCED SIMULATION AND COMPUTING (ASC) CAMPAIGN								
Goal: Provide the computational science and computer simulation tools necessary for understanding various behaviors and effects of nuclear weapons for responsive application to a diverse stockpile and scenarios of national security.								
INDICATOR	**ANNUAL TARGETS**							**ENDPOINT TARGET DATE**
	FY07	**FY08**	**FY09**	**FY10**	**FY11**	**FY12**	**FY13**	
CAPABILITY COMPUTING: The annual percentage of usage of ASC capability platforms for simulations that use at least 30% of the platform capability, as defined by total available node hours.	Baseline	18%	25%	32%	39%	45%	45%	By 2012, use 45% of the total each ASC capability platform for simulations that use at least 30% of the platform capability.
COST EFFICIENCY: The annual cost ($Ms) per petaFLOPS (quadrillion floating point operations per second) to procure, upgrade, operate, manage and maintain ASC computing platforms.	Baseline	1,089	762	534	320	192	121	By 2015, achieve a decrease in the life-cycle cost per petaFLOPS to $100M from FY2007 Baseline.
Code Predictivity milestones	Deliver a physics-based sub-grid model to support energy balance resolution (LLNL) Enhanced Pu multiphase Equation of State capability (LANL) Predictive failure capabilities in SIERRA mechanics (SNL) Fundamental simulations of material response and plasma physics on HPC platforms (LANL)							
Stockpile Impact milestones	ASC simulations supporting the National Technical Nuclear Forensics Attribution program (LANL) Assessment of nuclear physics uncertainties (LLNL) ALEGRA-HEDP Validation for Z-pinch implosion applications (SNL) Aged temperature/radiation aware model of Complimentary Metal Oxide Semiconductor integrated circuit technology (SNL)							

ADVANCED SIMULATION AND COMPUTING (ASC) CAMPAIGN								
Goal: Provide the computational science and computer simulation tools necessary for understanding various behaviors and effects of nuclear weapons for responsive application to a diverse stockpile and scenarios of national security.								
INDICATOR	**ANNUAL TARGETS**							**ENDPOINT TARGET DATE**
	FY07	**FY08**	**FY09**	**FY10**	**FY11**	**FY12**	**FY13**	
Capability Computing milestones	Infrastructure Deployment Plan for ASC Petascale Environments (LLNL, LANL, SNL)							

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